THE ECONOMICS OF LAND DEGRADATION

Policy Brief

The Economics of Land Degradation Neutrality in Asia
ELD ASIA Report 2017

Key messages

- During 2002–13, the average rate of soil loss for Asian countries was found to amount to **11.91 tonnes per hectare per annum**.
- As a result, the annual aggregate crop production loss was **1.31 billion tonnes** (about 53 % of the annual crop production in Asia), amounting to **USD 732.7 billion**.
- On average, the NKP[1] nutrient reserve of Asia's arable soils decreased by **108 kg per ha per annum**.
- If Asian countries invest in sustainable land management technologies on agricultural lands, benefits would be much larger than the costs.
- Through sustainable land management practices, productivity could **increase from 5 up to 8 tonnes** per ha per annum.
- Investing in these Sustainable Land Management technologies with an aim to achieve land degradation neutrality alone could enable Asian countries to reduce their poverty gap to zero by 2030.

Background

Land degradation and desertification is one of the world's greatest environmental challenges and currently being accelerated by a growing world population, alongside climate change and an increasing demand for goods produced from land like food and fibres. Over the past four decades, desertification has affected around 33 per cent[2] of the global land surface and erosion has removed nearly one-third of the world's arable land from production[3]. In terms of people affected, Asia has seen the biggest impacts. The continent holds almost

© GIZ/ Andreas König

60 per cent of the world's population. Of this, almost 70 per cent live in rural areas, and their livelihoods and sustenance directly depend on productive land based ecosystem services.

The global community has acknowledged the risks that degradation poses to stability, food security and livelihoods formulating Sustainable Development Goal (SDG) 15, *"Life on Land"*. By 2030, this goal aims to protect, restore and promote the sustainable use of terrestrial ecosystems. Target 15.3 specifically states that *"By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral (LDN) world."* The United Nations Convention to Combat

1 *Nitrogen, Phosphorus & Potassium*
2 *Eswaran, H., Lal, R. & Reich, P. F., 2001. Land Degradation: an Overview. Proceedings of the 2nd International Conference on Land Degradation and Desertification, Khon Kaen, Thailand: Oxford Press*
3 *Fischer, G., Hizsnyik, E., Prieler, S. & Wiberg, D., 2011. Scarcity and abundance of land resources: competing uses and the shrinking land resource base. SOLAW Background Thematic Report – TR02, s.l.: FAO.*

Desertification defines LDN as *"a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems."* Progress on the goal is to be measured with by an indicator of "proportion of land that is degraded over total land area", and several sub-indicators of land cover and land cover change, land productivity, and both above and below ground carbon stocks.

In response, several empirical and scientific methods for monitoring, assessing, and reporting progress towards SDG 15.3 as well as other relevant SDG targets have been developed by the international and scientific community. However, empirical studies integrating biophysical indicators with socioeconomic factors are limited, particularly at the national level. Generating empirical evidence based on biophysical and econometric modelling approaches is crucial to provide a framework in which the costs and benefits of interventions against land degradation could be assessed at different spatial and temporal scales.

These type of results are essential tools for policy makers, practitioners, and other stakeholders as it allows for informed decisions to be made towards sustainable land management. Moreover, such studies highlight policy implications and the interdependent nature of achieving a specific SDG target with other SDGs and targets.

Objectives

- Assess the economic benefits and costs towards achieving land degradation neutrality in Asia with a focus on the agriculture sector.
- Provide information on how investment on sustainable land management is cost-effective.
- Assess the policy implications of achieving SDG 15.3 on economic growth (SDG 8.1), rural employment (SDG 8.5), poverty reduction (SDG 1.1 and SDG 1.2), food security (SDG 2.3 and SDG 2.4),
- Suggest ways to integrate value of land as a natural capital in social accounting matrices of nations.

Methods

The study provides a continental level empirical analysis of arable and permanent cropland area of **487 million hectares** cultivated with more than **127 crop types**

© GIZ / Michael Kottmeier

accounting for **87% of Asia's total arable and permanent cropland** across **44 countries** and 2 provinces of China over 13 years (2018–2030). This was done by integrating biophysical modelling of soil nutrient balance in agricultural ecosystems[4] with econometric modelling[5] to estimate the net benefits of investing in sustainable land management. National level economic and biophysical data[6] from **2002–2013** was used, focusing on regional estimates for Asia and a cost-benefit analysis of sustainable land management technologies to achieve SGD 15.3 and other related goals.

4 *Sheldrick, W.F., Syers, J.K., Lingard, J., 2002. A conceptual model for conducting nutrient audits at national, regional, and global scales. Nutrient Cycling in Agroecosystems 62: 61–72.*

5 *ELD Initiative & UNEP, 2015. The Economics of Land Degradation in Africa: Benefits of Action Outweigh the Costs. A complementary report to the ELD Initiative. ELD Initiative and UNEP (2015) Report. ISBN: 978–92-808–6064-1. http://eld-initiative.org/fileadmin/pdf/ELD-unep-report_07_spec_72dpi.pdf*

6 *FAOSTAT, 2017. http://www.fao.org/faostat/en/#data; World Bank Database, 2017. http://data.worldbank.org/; WOCAT Database, 2017. https://qt.wocat.net/qt_report.php#results*

Main Results

Soil NPK balance: The aggregate annual soil NPK nutrient balance for Asia was –60 million tonnes, indicating an annual depletion of 52 million tonnes of NPK from soil nutrient reserves at a depletion rate of 108 kg per ha per year. There was a considerable variation in this annual rate across sub-regions; the highest was in West Asia at 140 kg per ha, and the lowest was in Southern Asia at 82 kg per ha.

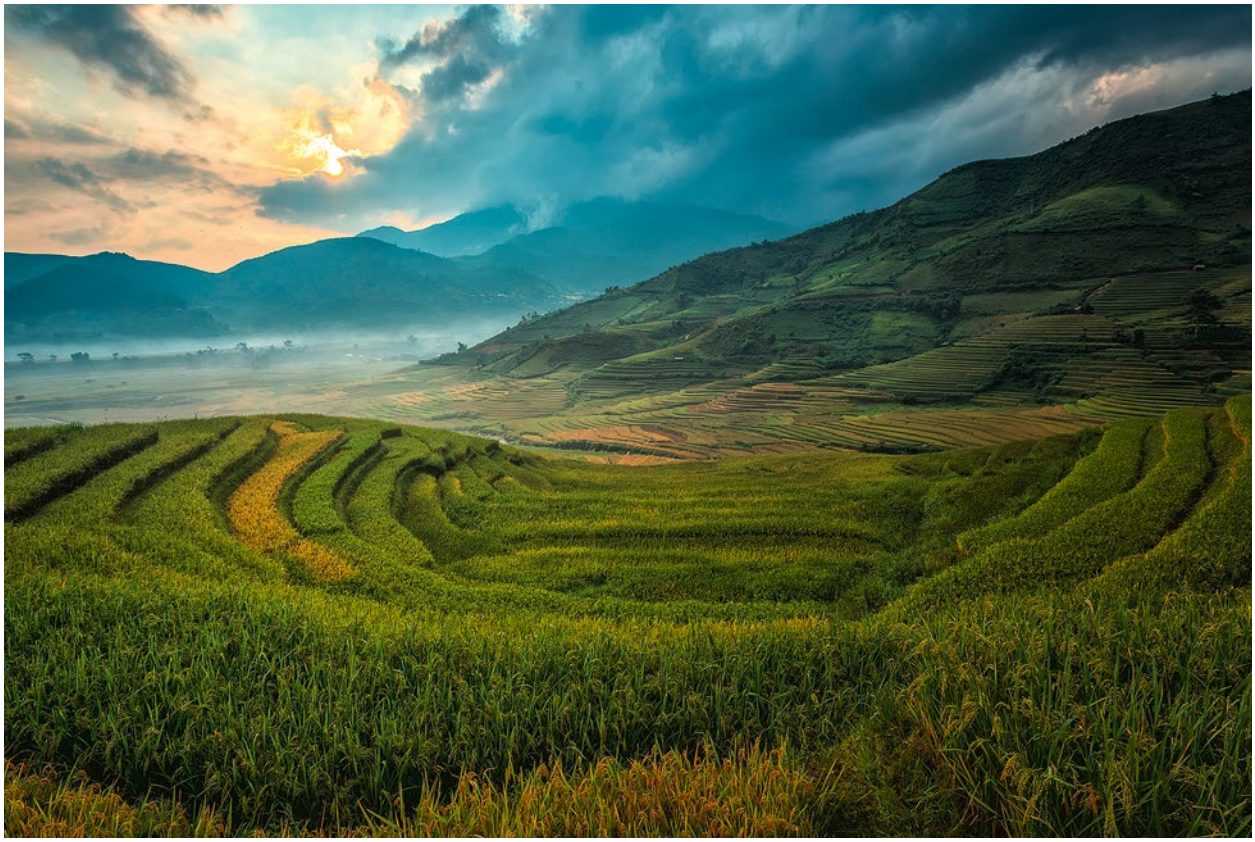
Soil NPK losses: Total losses increased from 60 million tonnes in 2002 to 73 million tonnes in 2013. The average annual rate of NPK loss over the 12 years was 139 kg per ha. The rate of top soil loss from agricultural lands was 12 tonnes per ha. From the total harvested area of the 487 million ha, loss amounted to 5.8 billion tonnes. Top soil loss induced soil NPK depletion amounted to about 50 million tonnes (102 kg/ha/yr) with a replacement cost value of about 30.1 billion USD.

The corresponding estimated top soil loss induced NPK loss amounted to 52 million tonnes (about 107 kg/ha/yr). The costs to replace this ecosystem service loss through commercially applied fertiliser at a weighted average price of USD 0.85 per kg of nutrients (2013 prices) were about USD 34.1 billion.

From 2002–2013, Asia produced close to 2.5 billion tonnes of crops across the 487 million hectares in the study, with an average annual regional productivity of 5 tonnes per hectare. Over the same period, on average for every kg of soil NPK depletion caused by top soil loss, productivity was declining by 17 kg of crop outputs. For every kg of NPK loss caused by top soil loss, regional crop yield loss declined by 0.32 kg.

Total annual aggregate crop production loss due to top soil loss induced soil NPK depletion amounts to about 1.3 billion tonnes or close to 53% of annual total crop production. The corresponding value of this loss at the weighted average crop prices amounts to USD 733 billion. This implies that avoiding top soil induced soil NPK depletion in the agricultural lands of Asia would increase regional productivity from 5 to almost 8 tonnes/ha/yr.

The estimated establishment costs for sustainable land management in 2013 prices range from USD 135 per ha in Myanmar to USD 20,152 in Hong Kong, with an average of USD 3,676 USD per ha. Whereas for the annual maintenance cost, the estimated result ranges from 132.58 USD per ha in Afghanistan to 16,778 USD per ha in Singapore with a mean of USD 1,981 per ha.



Results of the cost benefit analysis

The present value of the total costs of investing in SLM technologies in the study area is estimated to be USD 1,214 billion, a cost of USD 2,494 per ha. About 19% of this cost is for the establishment cost of technologies, with maintenance costs accounting for close to 58% in present value. Planning and implementation would cost 20.5% and monitoring and evaluation costs account the remaining close to 3% in present value.

The present value of the flows of total benefits from investing in sustainable land management is estimated at about USD 4,216 billion, equal to USD 8,663 per ha. About 98.4% of this benefit is accounted for by avoided crop production losses due to avoided soil NPK depletion, whereas the remaining 1.6% of the present value of benefits is from avoided crop production losses due to avoided NPK losses.

Asia could create a net present value of about USD 3,008 billion, equal to USD 6,182 per ha with a benefit-cost ratio of about 3.5. Seven countries (China, Saudi Arabia, Uzbekistan, Iran, Myanmar, Indonesia, and Japan) all together account for 88.34% of the net present value, with the ratio ranging from 3.02 in Japan to 6.75 in China.

The empirical results consistently indicate that the NPK loss as well as soil NPK depletion are significantly correlated with national level biophysical and socioeconomic factors and are positively correlated with top soil loss, size of economy (GDP), and livestock population density. They are also negatively correlated with forest cover. Aggregate yield is negatively and significantly correlated with NPK loss as well as soil NPK depletion, indicating that land degradation reduces productivity in agriculture. In addition, unlike land area, which is negatively and significantly correlated with yield, both human population and commercial fertilizer consumption are positively and significantly correlated with aggregate yield.

7 *According to the World Bank, poverty gap is the mean shortfall in income or consumption from the poverty line. It is expressed as a percentage of the poverty line. This measure reflects the depth of poverty as well as its incidence.*

Implications for other SDGs

SDG 1.1 & 1.2: No Poverty

The present value of the cost of reducing the poverty gap[7] by an average of 0.78 percentage points per year is estimated at about USD 959 billion, with annuity of USD 103 billion. Whereas the sum annuity of NPV of investing in sustainable land management technologies is about USD 258 billion. This is 2.5 times the annuity of the PV of cost of poverty reduction. This implies that investing in SLM technologies and achieving agricultural land degradation neutrality would enable countries to reduce the poverty gap to zero by 2030.

SDG 2.3 & 2.4: Zero Hunger

The baseline per capita domestic food crop production across Asia level 713 kg, but is predicted to decline to 587 by 2030 under a "business as usual" scenario. If countries invest in sustainable land management technologies on agricultural lands, per capita domestic food crop production gains will be 293 kg by 2019, 280 kg by 2025, and 271 kg by 2030. This implies that investments increase the total per capita domestic food crop production to 858 kg across Asia by 2030, which is 20.4% higher than current baseline per capita domestic food production.

SDG 8.1 & 8.5: Decent Work and Economic Growth

The real annuity of the NPV as percentage of 2015 GDP ranges from 0.02% in Kuwait to 9.3% in Myanmar. The real annuity as percentage of agricultural GDP for countries with positive NPV ranges from 1.26% in Azerbaijan to 34.67% in Myanmar. These imply that investing in SLM technologies would result in economic growth as well as expansion in the agricultural sector by the above indicated rates. GDP per capita growth is estimated at about 1.1% for China and 2.3% for India, which would apply over the 13 year period.

© GIZ / Dirk Ostermeier

Conclusions

- In addition to supporting the achievement of SDG 15.3, which aims to achieve a land degradation neutral world, investment in sustainable land management on agricultural lands in the next decade (2018-2030) would enable most Asian countries covered in this study to achieve a number of other related SDGs. These include economic growth and employment creation (SDG 8.1 and 8.5), eradicating extreme poverty and reduction of poverty (SDG 1.1 and 1.2), achieving food security through doubling agricultural productivity and income as well as ensuring sustainable food production systems (SDG 2.3 and 2.4).
- The study results also contribute to providing the methods and results for integrating the value of soil as a natural capital[8] in the national social accounting[9] matrices.

Recommendations

- Greater efforts are required to capture the benefits and costs associated with ecosystem services. Policies that fail to take a holistic approach to valuing ecosystem services will require amendments to ensure that land degradation is comprehensively addressed and thereby avoid seen and unforeseen social and economic costs;
- The countries of Asia, as well as regional and global stakeholders need to take action against nutrient depletion as a result of top soil loss, aggravating agricultural land degradation and productivity loss.
- Land degradation issues need to be mainstreamed into development frameworks, plans, and strategies need to take into account cultural implications that impact livelihoods;
- Policy recommendations should target all sectors involved in land use and management, drawing on the strengths of each in advancing sustainable land management;
- There is a need for more detailed information on how action can be implemented (pathways and toolkits for decision-makers), and;
- Larger investments in sustainable land management technologies are required across the Asian continent to harness the full potential and achieve food security and zero poverty.

8 *Stock of natural resources.*

9 *A system of presenting national accounts of a nation: United Nations, et al. (2009). System of national accounts 2008. New York*

ELD Initiative

The *Economics of Land Degradation (ELD) Initiative* is a global initiative established in 2011 by the *United Nations Convention to Combat Desertification*, the *German Federal Ministry for Economic Cooperation and Development*, and the *European Commission*. It is supported by a broad network of partners who aim at transforming global understanding of the economic value of productive land and at improving stakeholder awareness for socio-economic arguments to accelerate sustainable land management. ELD offers a universal approach to quantify the costs of land degradation as well as the economic benefits of sustainable land management.

The initiative is coordinated by the ELD Secretariat, hosted by *Sector Project Soil protection, Desertification, Sustainable land management (BoDeN)* at *Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)*.

For more information about this ELD study and the findings, please contact:
www.eld-initiative.org

ELD Secretariat
info@eld-initiative.org

Mark Schauer
c/o Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Friedrich-Ebert-Allee 36
53113 Bonn, Germany

THE ECONOMICS OF LAND DEGRADATION

UN environment
United Nations Environment Programme